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Item 10 (f) of the provisional agenda*

NATURAL DISASTER REDUCTION: WARNING SYSTEMS

Technical session

Programme

The technical session on warning systems has been organized by the World Meteorological Organization (WMO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

Objective. Many lives can be saved and enormous destruction of property avoided in natural disasters by warnings and response to the warnings, that is preparedness measures at all levels. The objective of this technical session is to provide an opportunity for an exchange of information on views between scientists, practitioners, users of warnings, policy makers and others concerned on all facets of warnings related to natural disaster reduction.

Output. Executive summary with conclusions and recommendations.

Part One (2 hours 5 minutes)

Presentations

Forecasts and warnings of natural disasters and the roles of national and international agencies.

Professor J. Hunt, United Kingdom of Great Britain and Northern Ireland

(15 minutes)

Risk management and assessment for natural hazards.

Professor Dr. E. Plate, Germany

(15 minutes)

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Impacts of warnings on loss of life and property caused by meteorological events: trends and future prospects.

Dr. R.C. Sheets, United States of America (15 minutes)

Flood and landslide warning systems.

Dr. M. Spreafico, Switzerland (15 minutes)

Earthquakes and tsunamis: ways of reducing risks.

Dr. E. Lorca, Chile (15 minutes)

A warning system for active volcanoes and responses to warnings.

Dr. R.S. Punongbayan, Philippines (15 minutes)

Screening

Video on natural disaster reduction: "How Meteorological and Hydrological Services Can Help".

(15 minutes)

Presentation

Dissemination of and response to community-based warnings.

Mr. T. Ono, Japan (15 minutes)

Technical Adviser: Dr. F. Yoshino, Japan

Part Two. Panel discussion (55 minutes)

The discussion will be led by a Panel moderator and six Panel members from governmental and non-governmental organizations of seven countries, ranging from those with large populations to a small island State, and experts active in various fields, including civil defence, community involvement, planning and development, science, engineering and technology, and the interface between warnings, preparedness and the media.

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Addendum

Forecasts and warnings of natural disasters and the roles of
national and international agencies

Summary of presentation by Professor Julian C.R. Hunt
United Kingdom Meteorological Office, United Kingdom
of Great Britain and Northern Ireland

Keynote topic

1. Natural disasters are caused by natural events which can be grouped as (a) extreme unstable events associated with rapidly growing instabilities of geographical "systems" in the earth, atmosphere and ocean, such as volcanic eruptions and tropical cyclones; (b) large "variability" events associated with extremes of the inherent variability and chaotic behaviour of geophysical systems, such as precipitation over long periods, El-Niño oscillations and extreme hydrothermal activity; and (c) global change events on decadal or secular timescales, which may have anthropogenic causes and which lead to such disasters as desertification or severe loss of ocean plankton.
2. Following any of the above-mentioned primary events, there may be equally harmful secondary events, such as mud slides or tsunamis following volcanic eruptions. Whether these events lead to disasters depends to a large extent on the preparedness and resistance of the afflicted community (i.e., its vulnerability). Forecasts for these different categories of events are of two types: first, precautionary forecasts or risk assessments based on data of previous events and, second, real-time forecasts for specific primary events derived by observations and by calculations, which may be deterministic

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or may be based on a combination of deterministic and statistical methods. For group (a) events, these forecasts only begin following some initial detection, whereas for groups (b) and (c), forecasts are made before any indication of the event. For different events in the ocean-atmosphere system, these forecasts may range from days to years. Once the location, nature and scale of the primary event is forecast or known, many (but not all) types of secondary events may be also forecast with increasing accuracy using local geophysical data (e.g., derived from satellites) and computational models of relevant processes (e.g., lava flow, flood waves, etc.)

3. The paper to be presented to the Conference describes the organization of forecasts and warnings and how it involves geophysical and disaster or emergency centres at the national, regional and international levels. A satisfactory system for issuing, receiving and acting on forecasts and warnings between countries by these centres (including the use of broadcasting media) requires carefully negotiated procedures at the intergovernmental level; for some kinds of meteorological and flooding disasters, these procedures have been agreed through the World Meteorological Organization. No such international procedures have been agreed for other geophysical events and disasters and since this may lead to a confused response by disaster and emergency services, it would be appropriate to investigate whether procedures similar to those developed through the World Meteorological Organization might be developed for these situations.

4. The final section of the paper reviews the need for defining targets for improvement in forecasting during the International Decade for Natural Disaster Reduction and considers that this should be preceded by establishing the accuracy of current methods (i.e., the baseline). Clarification of objectives and targets may well lead to greater financial support from Governments and other donors.

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Addendum

Risk management and assessment for natural hazards

Summary of presentation by Professor Dr. Erich Plate, Director,
Institute for Hydrology and Water Resources Planning, Germany

1. Risk management is a methodology that provides a framework for a logical approach to disaster management. It is presented as a chain of action, each stage of which is well defined and based on traditional engineering and management practices. The links of the chain are described verbally, as well as through the concepts of risk analysis. They are illustrated by references to flood and wind hazards.
2. Risk assessment is the first step in a risk management scheme, where the hazards are identified (e.g., floods and their recurrence intervals) as the basis for decisions on flood protection schemes. Hazard identification is, however, not enough; a flood occurring in a natural wilderness will have only limited consequences, whereas a flood in a heavily populated area may lead to extreme disasters. Human involvement is a necessary prerequisite for a disaster. This is quantified by means of risk analysis, in which the hazards as well as the consequences of the occurrence of an extreme natural event are considered.
3. The combination of hazard and consequences is the risk, which for natural hazards is ideally represented by risk maps. Very often, such maps suffice as a decision aid for risk mitigation measures, but the decision made depends also on the second step in the risk analysis chain: the evaluation of the

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risk. In order to be able to assess the consequences in monetary terms, or in terms of potential loss of life, one must consider the options that are available for disaster mitigation. Options range from comprehensive (and costly) structural solutions to complete absence of structural solutions, where mitigation is effected only by individual actions, such as reactions to more or less organized forewarnings, or individual protection against financial losses through insurance. The risk posed by a natural hazard is not an absolute criterium for deciding on the action to be taken; its reduction is one among many social goals, and the financial and other resources available must be suitably allocated for many different purposes. In the end, the final decisions on large-scale risk mitigation measures are made only if other needs are considered less pressing - an attitude that applies to Governments as well as to individuals. Whatever the decisions that are made, it can be stated that an additional protection against the threat from natural hazards is obtained by preparedness against disasters: structural strengthening of threatened buildings, preparation of emergency supplies, provision of medical services and, last but not least, training of people who are to be active in disaster mitigation, are all measures which complete the chain of risk management. Decisions on risk management for protection against large natural disasters are made according to criteria which are rooted in human factors depending on the social and political decision environment, as well as on financial constraints.

4. Much effort is given by the scientific community to the development of an analytical theory of risk assessment. The process of analytical risk analysis is an important step in the procedure of determining objective decision criteria for disaster management. The method, in spite of its rational foundation is not, however, used as much as it should be. It is a method which should work well in situations where probabilities can be obtained from relative frequencies. It is of little value in cases of rare events. Yet, it has been applied mostly to rare events and, because of its lack of credibility there, it is not considered useful in cases where it should work well as a valuable decision tool.

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Addendum

Impacts of warnings on loss of life and property caused by
meteorological events: trends and future prospects

Summary of presentation by Dr. Robert C. Sheets, Director,
National Hurricane Centre, National Weather Service,
United States of America

1. Loss of life from lightning, tornadoes and tropical cyclones has decreased markedly in the United States of America during the past few decades, notwithstanding the increasing populations at risk. This accomplishment is primarily attributed to improved preparedness efforts through the education of the population at risk on how to respond to warnings for hazardous meteorological conditions, excellent communications systems and the advancements made in the science of meteorology which permit more accurate and timely warnings. During the same period, however, the loss of property from tropical cyclones and tornadoes has increased markedly because more people and property are at risk than ever before. Only a fortuitous period of more than two decades of reduced strong tropical cyclone activity has kept losses from growing at even a high rate. Recent research indicates that that period of reduced activity may be ending.

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2. During the lull in major tropical cyclone activity in the United States of America, there was a major influx of people to the gulf and east coasts of the country. This rate of increase of people and property at risk to tropical cyclones has taken place at a much higher rate than improvements in the ability to forecast accurately where and how strong tropical cyclones will be when they strike a given community. The result is that there now exists in several coastal areas of the United States of America the potential for large loss of life from a single tropical cyclone event where adequate warnings may not be possible.

3. Although the presentation is focused on the tropical cyclone threat, many of the factors discussed and the mitigation activities suggested are equally applicable to other natural hazards, such as earthquakes, floods and, to some degree, tornadoes.

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Addendum

Flood and landslide warning systems

Summary of presentation by Professor Dr. Robert C. Sheets, Director, Hydrological and Geological Survey, Switzerland; Dr. Manfred Spreafico, Head of the Hydrology Division, Hydrological and Geological Survey, Switzerland; and Dr. Olivier Lateltin, Secretary, National Committee for the International Decade on Natural Disaster Reduction, Switzerland

1. Flood and landslide warning systems play a key role in emergency preparedness. According to the great variation in meteorological, hydrological, geological, topographical and morphological settings in flood and landslide endangered zones and the different infrastructures existing within these zones, many different systems exist throughout the world.

2. Different types of monitoring and warning systems have been in operation in Switzerland for many years. Within the framework of the International Decade for Natural Disaster Reduction and in close cooperation with the World Meteorological Organization (WMO), which has the international leadership in this field, these activities have been reinforced.

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3. Case studies of some selected flood and landslide warning systems which are in operation in Switzerland, are briefly described in the presentation. These include:

(a) A discharge forecast system for a large basin based on quantitative rainfall forecasts and rainfall-runoff modelling;

(b) A flood warning system based on automatic water level and discharge measurements;

(c) A system of forecasting the inflow in a regulated lake with the aim of pre-emptying the lake to gain flood-retention volume;

(d) A warning system indicating the failure of the dam of an artificial reservoir;

(e) A monitoring and warning system in a narrow alpine valley endangered by massive rockfalls (network of geodetic, meteorological and seismic stations).

4. The effectiveness of these systems will be the basis for a discussion on general problems associated with the implementation and operation of warning systems related to data collection, forecasting, warning dissemination, coordination, land-use planning and responsibilities in a decentralized country where disaster prevention and management are mainly in the hands of regional authorities.

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Addendum

Earthquakes and tsunamis: ways of reducing risk

Summary of presentation by Messrs. Emilio Lorca and Hugo Gorziqilia,
Servicio Hidrografico y Oceanografico de la Armada de Chile

1. Earthquakes occur along tectonic plate boundaries. In the past 500 years, 3 million people have died in major earthquakes. The rapid growth in population and industrial and harbour facilities increase the risks posed by earthquake and tsunami hazards. Tsunamis triggered by undersea earthquakes or volcanic eruptions have killed some 52,000 people around the Pacific basin in the past 100 years. Systems that warn populations of an approaching tsunami must work quickly since most deaths caused by the tsunami waves occur in the first 20 minutes and less than 100 kilometres from the source. Recent tsunamis which occurred in Nicaragua, Indonesia and Japan in 1992 and 1993, with hundreds of victims, have shown that actual tsunami warning systems do not provide sufficient lead time to save human lives within the near field.

2. In 1966, IOC established the International Co-ordination Group for the Tsunami Warning System in the Pacific, which identified the Seismic Sea-Wave Warning System of the United States of America, in operation since 1948 at the

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Seismological Observatory near Honolulu, as the Pacific Tsunami Warning Center (PTWC). The operational objectives of PTWC is to detect and locate major earthquakes in the Pacific region, to determine whether they have generated tsunamis, and to provide timely and effective tsunami information and warnings to the population of the Pacific in order to minimize the hazards of tsunamis, especially to human life and welfare.

3. No such warning system exists as yet for major earthquake occurrence. Monitoring by a large number of instruments throughout the world is supporting and encouraging the research efforts aimed at the development of forecasting techniques for appropriate application in regard to time and place.

4. There are several ways of reducing risk from tsunami hazards. One is by assessing vulnerability, which can be attained through two methods: evaluation of historical impact from tsunamis and numerical simulation. Tsunami risk is essentially a function of land uses interacting with tsunami characteristics. There are two approaches to tsunami risk reduction: construction of barriers and risk management policies.

5. The development of regional and national tsunami warning centres using new operational concepts will reduce the time needed to evaluate the tsunami hazard, to make decisions and to disseminate the warnings.

6. Most of the mentioned risk reduction measures are expensive and take a lot of time to implement. The developing countries at risk, most of which are located at the rim of the Pacific basin have a better chance of reducing earthquakes and tsunami hazard through a comprehensive education programme on both of those natural hazards.
